HOW DO WE KNOW WHAT we KNOW about HORMONES

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HumDrumPress

THIS IS NOT A BOOK ABOUT HORMONES.

This is a book about how we, humans, think about our hormones, and how we know whatever it is that we know about our hormones.

Hormones are how our bodies talk to themselves, typically without the involvement of our thinking-selves. It can be tempting to consider the activity of thinking, or the experience of agency, as uniquely and importantly human. This implicit hierarchy of experience leads to an expectation of understanding and control. It also leads to frustration when we discover that neither full understanding, nor full control of our bodies is possible. Hormones are one such bodily reality that defies full understanding and full control. Moreover, our hormones are implicated within experiences of time and change, which in themselves can already be considered challenging experiences.

I myself am not an expert on hormones in general, or even hormones in my own body. Still, I am a person with a body, and every day I act on matters of my embodiment, my bodily health and wellbeing in which I see clearly the limits of my knowledge. Through my artistic and performance practice, I have worked with certain kinds of collective reflection processes; a meandering, multifaceted pathway towards a place of understanding. Through its components and chapters, this book is a compilation and expanded reflection of this process in which you are invited to join.

If there is one thing I hope you get out of this book, it is to show how it is useful and fun to talk to other people about bodily experiences, even ones that defy clear explanations or direct control, like those associated with the strange overlapping chatter of hormones.

Additionally, noticing or talking about the body often happens in the wake of disruption or damage. As long as the body is working, its subtler ways of operating don't typically get as much attention.

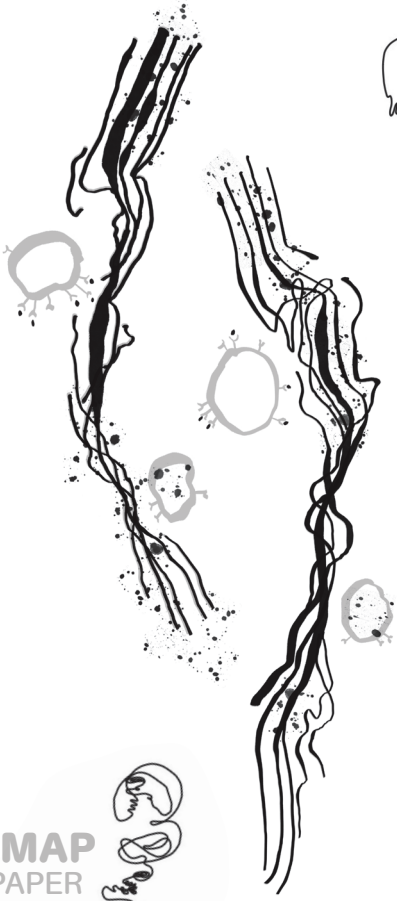
The drawings in this book are body maps created by the participants of the School of Commons* 2022 cohort, in sessions facilitated by the author, as well as the author's own illustrations.

This book contains a number of interactive invitations, or reflection exercises, which are informed by aspects of personal practice in relation to systematic self-reflection. However, this book is not itself about those personal experiences. I hope that the invitations in this book create space for embodied reflection in its own right, as a playful and curious activity.

This book concludes with Ekat Osipova's essay on bodily transgressions meeting medical practice. Biomedical knowledge can be essential, fascinating, and, importantly, lifesaving. Practices of collective sensemaking and story-telling that the body experiences can be all of those things, too. At its best, each supports, and is supported by, the other, as we learn to navigate complex bodily experiences that refuse understanding and control.

This is not a book about hormones: it is a book about the collective encounters that we can have while making sense of our respective, shared interiority. An interiority that is neither passive nor silent, but rather abuzz with constant chemical communication.

*School of Commons (SoC) is an initiative dedicated to the study and development of self-directed peer learning. SoC represents an international community of practitioners, artists, designers and researchers who focus on matters surrounding the production and mediation of knowledge.



INVITATION #2 BODY MAP

MATERIALS: PEN/PENCIL AND PAPER

SOLO VERSION: Placing the pen on the paper and looking away, or closing the eyes, start a body scan meditation. Move your awareness slowly from one specific, localised organ or area of the body to another. Move your hand along with your awareness, without looking at the paper again. For example, one possible path through the body may be: first the major external features (eyes, shoulders); then major well-known internal features (heart, ribs); then viscera that are known but cannot typically located (pancreas). Any other choices of parts, their order; or the scan's pacing, is open and welcomed.

GROUP VERSION: Take turns leading the whole body scan. Allow the choice, order, and pacing to shift and change with each turn.

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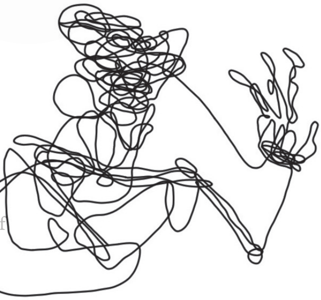

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GROUP VERSION: Take turns leading the above body scan. Allow the choice, order, and pacing to shift and change with each turn.

THE MECHANISM(S) OF HUMAN SELF-UNDERSTANDING

Before we talk about hormonal experiences, which are pervasive as much as they are resistant to direct control, what about our bodily experiences more generally? How do we know what we know about our bodies?

The way I understand my body shapes the way that new knowledge—experiential or theoretical—adds to that understanding. In "The Quantified Self," Deborah Lupton [1a] talks about technology, including self-tracking as well as biomedical imagery and bodily understanding. She observes that the cultural ubiquity of medical images and the use of consumer self-tracking devices has shifted the sense of objectivity outside the body, toward the device itself:

...where once people relied upon the sensations they felt in their bodies and reported to their physicians, medical technologies devoted to producing images of the body have altered the experience and treatment of bodies. The optic has come to take precedence over the haptic in revealing the 'truth' of the body". Such technologies produce a virtual patient, a "screen body." The visual images of the data they generate are often privileged as more "objective", and "as part of the project of seeking security and stability, such technologies attempt to penetrate the dark interior of the body and to render it visible, knowable and thereby (it is assumed) manageable. [1a]

Around the same time that I was reading this book, I was also studying yoga. The notion of self-study within yogic philosophy is disciplined, but without the aim of control, and without attachment to a specific goal which may cause suffering. [1b] Though the technologies of bodily seeing and bodily monitoring suggest or encourage a particular kind of goal (control), maybe it is possible to use those technologies of seeing without an attachment to that goal?

INVITATION #2: THE FOUNDATION

What are the ideas that influence how you receive information about hormones, from your own body; from your trusted peers; or from the media? What are the biggest anchors or points of reference for you in your own journey of building your body knowledge more generally?

The answers to the above can be approached as a list; a timeline; or a mind-map.

There is nothing I can teach you about hormones. Rather, I offer ideas about building one's body knowledge by pulling on a few of the many different possible threads, and doing so together. When I say "together," I mean within a community of peers, curious about our respective bodies and their respective, complex experiences. Those who are curious to engage with the wide-ranging body of contemporary research on the human experience.

When it comes to hormones, we humans are not alone in the way our bodies are complex systems whose chemical communication we, in many cases, can only influence, but not observe or change directly. So, when I say "we" and "us," I mean the community of curious peers, but I also mean the broader community of beings with whom we share one or more pathways of internal communications that govern internal cycles and rhythms, and how we react to external stimuli. We can know more about stress, hunger, excitement, and rest not only through experience and study, but, for example, also through interactions with non-human companions.

In "Eating in Theory", Annemarie Mol suggests understanding human beings not (only, exclusively) through their (implicitly exceptional) capacity to exert agency (such as to pursue goals and exert control), but through the capacities they share with many other creatures. [1c] Hormonal experiences elude our control (mostly to our frustration)—also something we share with a vast number of other non-human beings. [2a] Thus, I would like to bring in the perspective of an "us" as eaters, rather than agents exerting control, as evidence of consciousness. As agents, we might focus on our ability to plan, to shape reality, to move through space, exerting control through action. As eaters, though, we allow the space to move through us, and we can focus on the more subtle experiences that are so much more common across the living beings we share our space with. There is agency in the many acts related to eating and digestion, but there are also many more hidden sensory experiences and unseen microbial collaborations which remain outside of complete control or complete understanding.

Hormones, like dopamine, motivate us to act on hunger: hormones, like leptin and ghrelin, help us understand our hunger; hormones, like insulin, maintain energy homeostasis. Of course, goal-oriented action is literally vital to the daily act of eating. Control and understanding are already well-represented in empirical studies of the human body, and can play into part of what "The Quantified Self" refers to as an internalised neoliberal ethos of self-optimization, which further strives for the goal of bodily control through bodily understanding. [1a] However, even if neither control nor observation is perfectly possible, there is still much to learn from many different kinds of hormonal epistemologies, or knowledge-making approaches.

CYCLES & SIMPLIFICATIONS

Hormones govern internal cycles and rhythms, as well as how we react to external happenings. There are many hormonal messages and hormonal experiences—not only within humans. Some of these mechanisms are ancient, such as sleep:

Melatonin, a sleep-inducing hormone produced in the first half of the night by the human pineal gland, would appear to have originated 700 million years ago, when animals resembling marine worms evolved cells capable of capturing light and moving around with the beating of cilia during the day, but not at night. The mechanism of this dichotomy was the night-time production of melatonin, which in the absence of light stimulated neurons to stop the movement of cilia. [2a]

In today's watery depths unfolds the silent, horrifying reality of the dying corals, which Paul Huebener writes about in "Nature's Broken Clocks:"

[From the corals'] perspective, the problem today is not just higher temperatures and increasing acidity but also the rate at which these changes are occurring. It is one thing to adapt to changes that occur at a gradual pace over thousands of years, but another thing entirely to respond to waves of heat that arrive rapidly, one after another, with shorter and shorter pauses for recovery in between. Current scientific research on helping the corals includes, among other things, "assisted evolution," where [chunks of coral are bathed in water that mimics the warmer and more acidic oceans] · subjecting the corals to a kind of hopeful agony, submerging them in the hostile conditions of an increased pace of life. [2b]

Shifting conditions outside of a body influences the conditions inside that body. In humans, hormones are essential internal mechanisms that make that possible, such as the evolution of a relationship that might be simplified as: "no light? Release the melatonin!" In such simplifications, there are truths, as well as omissions. The greatest omitting simplification about hormones is perhaps the colloquial use of the word "hormonal" to describe (and diminish) a whole range of experiences. Hormones do much, but a casual mention of hormones without specification rarely suggests "sleep" or "hunger" or any of the other core cycles hormones are involved in. How we talk about hormones influences what we know about hormones, and how we simplify hormonal experience is an important part of that.

Within the biomedical sciences, some bodies are far less studied than others, with a widespread historical exclusion of menstruating subjects from both animal and human drug research because of the inconvenient bodily seasons created by ovarian hormones. Addressing the myth that "using females means we need to know the estrous cycle phase or remove the ovaries" [2c] within neuro-

science, Shansky and Murphy point out that "ovarian hormones are unquestionably powerful neuromodulators, but ... gonadal hormones are not a uniquely 'female problem' for neuroscientists. Examining the influence of the estrous cycle on a particular experimental question is always an option, but is not required for research in females, just as assessing testosterone levels (which can vary up to tenfold across a cohort) is not standard practice for experiments in males." [2c] Despite institutional efforts to include more representative subjects in studies, many studies continue to underreport relevant information and rely on "misconceptions surrounding the hormonal variability of females". [2d]

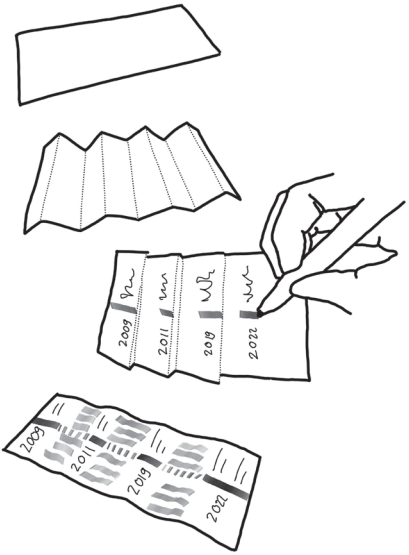
Simplifications are useful, and, perhaps, unavoidable tools. However, they can also become harmful when taken for granted without consideration—both in daily, casual language, and in more systematic knowledge-building contexts. The following exercises invite simplification, but they also invite revision, annotation, and layering.

What if we embrace the simplification of hormonal experience as a playful imagination of possibility? Everything (more or less) affects everything (more or less), on different scales and time patterns, and in different ways. Playing with simplifications invites asking yourself (and the bodies of knowledge available to you) about the nature of each relationship, its temporality, and the assumptions that might be otherwise hidden.

Hormones are a communication system. Chemicals that are released from some cells travel through the body's blood circulation system, and bind to the receptors of other cells. The chatter of hormones overlaps in time and space. At any given moment, in any given specific area of the body, multiple messages may be at play.

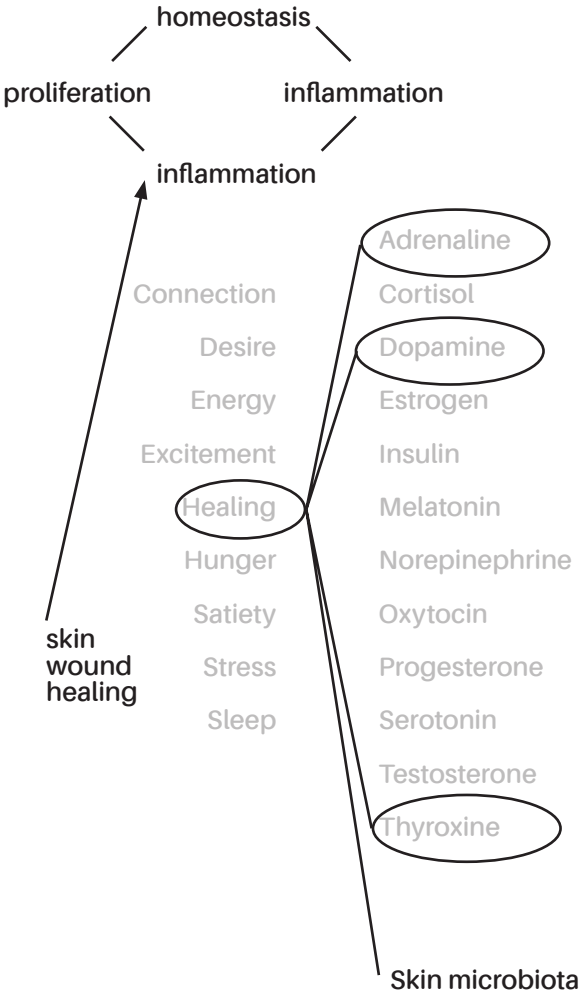
INVITATION #3: RHYTHM AND EVENT ARCHAEOLOGY

Draw daily, weekly, monthly, and yearly rhythms. You can focus on things like hunger/satiety, sleep quality or duration, and stress. Try to excavate from past experiences. You can fold a piece of paper like an accordion and make a note of the timeline of a major event in your life. Then you can expand it and fill in how the rhythms might have been similar or different in those periods.



INVITATION #4: IMPACT LINES

Draw lines between the bodily experience(s) and the hormone(s) that are connected. Consider using different colour pencils or pens to express different types of relationships. In the process of mapping the impact lines and relationships, centre revision, annotation, and layering.



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	Adrenaline
Connection	Cortisol
Desire	Dopamine
Energy	Estrogen
Excitement	Insulin
Healing	Melatonin
Hunger	Norepinephrine
Satiety	Oxytocin
Stress	Progesterone
Sleep	Serotonin
	Testosterone
	Thyroxine

EMBRACING COMPLEXITY

It is also a simplification to see the human body as a closed-off thing, separated from the outside environment. The skin forms that barrier, but it is itself porous, both inhabited by non-human microbial coresident creatures, and involved in the loud hormonal discourse of the body. Consider, for example, wound healing:

> *Skin microbiota has been reported to participate in orchestrating the wound healing [process] ... many bacterial species on human skin are able to convert aromatic amino acids into so-called trace amines (TAs) and convert corresponding precursors into dopamine and serotonin, which are all released into the environment. As a stress reaction, wounded epithelial cells release the hormone adrenaline (epinephrine) [which has the effect of impairing the process of resurfacing the wound with new flesh. At this point, the TAs limit the effects of adrenaline. The result is that not only TAs but also TA-producing skin bacteria accelerate wound healing.* [3]

In other words, on the surface of the skin, microbiota participate actively in the hormonal chatter of the human body and support the healing process in multiple different ways that would certainly overlap with other processes in the body. A great deal goes on that involves dopamine, serotonin, and adrenaline—not just the healing of a scrape!

Expanding our view of hormones in this way—to imagine the porous body boundary, and to include the influence of non-human participants renders the story and the picture of hormones even more complex than we've already established. However, complex does not mean "unknowable", it means difficult to isolate. Complex does not mean "beyond the capacity of change or deliberate influence", it means difficult to control in a direct or simple way. The complex systems view of the body can help to hold the reality of the astounding complexity of that body without giving up on its study through many methods, including empirical study of body processes and therapeutic interventions.

What makes the hormonal regulation of bodily cycles a complex system is that multiple nonlinear relationships overlap to create a stable state. Both influences and effects build on each other and interact. For example, consider sleep again: though melatonin plays a very important role in sleep, it is not the only hormone (internal chemical messenger) that matters to sleep regulation and dysregulation *(e.g., insulin)*; and sleep is not the only aspect of bodily experience it influences *(e.g., the immune system)*. This is true of hormones generally: it is a loud chatter of many overlapping voices. Relationships between internal and external signals are many, connecting the

environment within the body to the environment beyond it.

Even in a stable state, hormones are not static. Hormones form a complex interconnected system. This can go in and out of relative stability or balance, and it can be influenced, though the influence is not typically direct. There is no way to change, or even directly and reliably observe how much of a hormone there is, and what impact precisely this has. This is a subject of much ongoing research. [4]

How do you know there is a disturbance? Symptoms can be vague: disrupted sleep, bad dreams, strange fluctuation in levels of energy. Although direct observation and control of hormones may not be possible, there are many ways to influence this complex system of chemical communication and regulation, both through medical intervention, where appropriate, and through many actions that are readily available.

SINGING

as an Example of Complex Relationships between Hormones and Embodied Experience

Singing? Yes.

Singing improves mood and reduces stress; choir singing in particular reduces both salivary cortisol and the subjective experience of stress. [5a]

Stress and excitement as subjective experiences are not synonymous with levels of cortisol, because of the ways that we make meaning around the experience of both excitement and stress. We can be physiologically stressed, such as in a game, and not interpret or describe it as stress. Observing and understanding cortisol, for example, helps to understand stress response, but the presence of cortisol itself offers an incomplete picture of the experience of stress.

INVITATION #5: SINGING IN A SHARED SPACE

When was the last time you sang, or chanted, with other people in a shared space? You can use this space to annotate the body with your own experience; when you sing, where do you feel it, and how does it feel? Are there differences between singing alone or in a group?

Two studies [5a] looked at cortisol and oxytocin [5b], and compared choir and solo singing.

The HPA axis controls stress reaction. H refers to the hypothalamus, which releases CRF in response to stress. In response to the release of CRF, the pituitary gland produces ACTH, which in turn causes the adrenals to produce corticosteroids, including cortisol.

Oxytocin is both produced not only in the brain, but also throughout the body, including in the heart, thymus, gastrointestinal tract, as well as reproductive organs.

Oxytocin receptors are even more widespread. The expression and pathways of oxytocin are the subject of ongoing research.

Singing engages many parts of the body, most directly the nasal and oral cavities, the larynx, and the lungs. However, the whole body can become involved. The use of lungs means that the diaphragm is involved. The efficiency of breathing is dependent in part on posture; so the legs and the spine are important supports.

Both studies [5a] used oxytocin and cortisol concentrations in saliva. Though this has some limitations, it is also minimally stressful for the study participants. In addition to saliva measurements, the researchers asked participants to self-report their emotional state using validated surveys.

You can imagine the diaphragm as a big umbrella under the lungs. It is a powerful muscle, activated on the exhale, and relaxed on the inhale. Diaphragmatic breathing helps improve the efficiency of breathing, and thus can help with singing practice.

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I AM AN EATER AND I AM A SLEEPER

What if we think of ourselves as eaters and sleepers, whose bodies can be invited into a cascade of many complex actions, most not directly controllable or even observable? [1c] Just as stress and excitement as subjective experiences are not reducible to measurable levels of cortisol, no one single chemical messenger corresponds to the subjective experience of having or lacking energy, and no one single chemical messenger corresponds to the many steps in the process of food intake by which an energy homeostasis could be maintained. But hormones do play an important role in regulating energy balance, and if one hormone must be associated with energy, perhaps it ought to be insulin. [4b]

Invitation #6 is about keeping a daily diary related to energetic recovery. Although it is more directly related to sleep than to food, there is a hormonal basis for exploring this connection. Poor or disrupted sleep impacts our food cravings, and our ability to produce insulin effectively, because disruption of melatonin (signal to sleep) can disrupt insulin production or limit efficiency. This can lead to more cravings, and thus more, or more pronounced, "sugar crashes". A sugar crash is the result of eating carbohydrates or sugars that spike blood glucose levels; cause an excessive production of insulin; and this in turn lowers the blood glucose level to a point that feels distressing.

Both food and sleep behaviours are notoriously difficult to change, but they also influence each other, and small changes in concern to both can have more profound effects. Better and longer sleep reduces cravings; eating not too close to bedtime (part of good "sleep hygiene" [4f]) also improves sleep quality. In this example, shifting the time of the last meal earlier if possible can impact both sleep and eating positively.

The mechanisms and behaviours around sleep and food are different, but they overlap in terms of impact, and in terms of subjective experience. If I consider my energy first from an experiential perspective, and find areas I would like to improve, I can then think about which behaviours are currently within my influence that I can make small, but potentially helpful, adjustments to.

INVITATION #6: ENERGY DIARY

This is an individual reflection exercise, involving a pen and paper kept by one's bed, to be filled out in the mornings. Create a table with a row for each day, and columns for "Yesterday" and "When I Wake".

Optionally, other columns, or a column for notes can be interesting; for example, because unusual sleep disturbance may be a good signal to keep track of, this may be worth leaving space for. In each of the main 2 columns, record every morning a number from 1-5:

In "Yesterday": How energetically demanding was the prior day?

1. Very few energetic demands (not necessarily relaxed)
2. Fewer energetic demands than average
3. An average amount of energetic demands
4. A bearable amount of energetic demands, but not sustainable for a long time
5. An unbearable amount of energetic demands

In "When I Wake", consider how ready you feel for the day ahead:

1. I feel very capable to undertake the challenges that I face today
2. I feel capable of undertake many of the things ahead
3. I feel an average amount of interest
4. I am somewhat dreading the day ahead, but it will be alright
5. Starting this day requires an impossible amount of effort

Feel free to rephrase these in ways that resonate more. Keep the diary for a few days or weeks. Then, go through and consider: are the numbers what you expected? Where do the differences from your expectation arise?

For each day, you can also calculate the level of recovery: "When I Wake" number minus the "Yesterday" number. Are these mostly positive (even when there are many demands, there is some recovery overnight) or negative or zero (limited access to recovery)?

THE RHYTHM OF THE HEARTBEAT

INVITATION #7: RESONANT HEART-BEATS

MATERIALS: PAPER, PEN OR PENCIL, A TIMER, AND AT LEAST 3 PEOPLE PARTICIPATING.

Take 1–3 minutes to make tick marks with a pen/pencil on a piece of paper every time your heart beats. After you're done, take a moment to talk about what it felt like, and what came up. Try different settings and durations.

You can try this exercise in person, or over a video call. The pens and pencils against paper make a chorus. The chorus longs for a rhythm that is both inescapable and unattainable. As they make tick marks, people become drawn to the sounds of the others, or distracted by them. They try to either match or overpower what they hear outside the body with what is arising inside the body. When you observe your heartbeat, you can also change it; maybe not much, but certainly a little bit; maybe even a little bit more with practice. As the group is making tick-marks, tak-tak-tak, inevitably some people will start to draw their heart beats into a matching rhythm. Two people with pencils in chorus, but who have picked a different moment in the circulatory beat for tick-mark-making, are making a different song with their hearts.

This exercise has three key goals within the context of an in-person workshop. It (1) centres on the body, as it can be challenging to find the heartbeat; (2) supports starting a discussion about data observation—when did you make the tick-mark? Did observing it change it? And (3) creates a shared, embodied experience through sound. [6]

CHANGE AS A TEACHER

How do we know what we know about hormones? Personal experience: especially of change, which is mostly perceived as difficult.

On this subject, I invite you to imagine a metaphorical small sea creature that is exposed to unimaginable challenges, both beyond itself and within itself, but that, with its community of peers, manages to keep singing itself back together.

Earlier, I had quoted from Paul Huebener's "Nature's Broken Clocks:"

[From the corals'] perspective, the problem today is not just higher temperatures and increasing acidity but also the rate at which these changes are occurring. It is one thing to adapt to changes that occur at a gradual pace over thousands of years, but another thing entirely to respond to waves of heat that arrive rapidly, one after another, with shorter and shorter pauses for recovery in between. Current scientific research on helping the corals includes, among other things, "assisted evolution," where [chunks of coral are bathed in water that mimics the warmer and more acidic oceans] · subjecting the corals to a kind of hopeful agony, submerging them in the hostile conditions of an increased pace of life [2b].

I had included this textual image as one of the examples of the interconnection of the rhythms of a body and its environment. This image is disturbing—as is its literal subject, and as is the metaphorical experience of change that is imposed from beyond. However, even internal, intentional change poses a significant journey. In one of the stories in "Things that are," Amy Leach writes:

The floor of the sea is also the setting for the potentially dramatic life of the sea cucumber. [...] Every year, for three weeks, it melts down its respiratory and circulatory systems and then rebuilds itself. The danger is that if it gets warm or stressed during this restoration period the poor frail cucumber will burst, expelling all its softened heart-soup. Please do not yell at the sea cucumbers. [7]

Beyond these images of hopeful agonies lie, perhaps, the imaginations of singing and resonance: after the body of Osiris is disintegrated, Isis chants him back into wholeness. [5c]

STORYTELLING AS LEARNING

How do we know what we know about hormones?

Stories.

Some are detailed; some are reliable; some are relatable.

Many are intended to shame, dismiss, and mislead.

Many claim more certainty than is possible in such a complex system.

It's important to practice storytelling the body with its many interior journeys; and it's important to practice storytelling together.

The concluding essay by Ekat Osipova reflects on the importance of storytelling within the context of biomedical knowledge. At their best, these ways of knowing support and strengthen one another, as integral parts of a collective sensemaking process.

INVITATION #8: COLLECTIVE HORMONE EPISTEMOLOGY

MATERIALS: CURIOSITY AND PEOPLE YOU FEEL COMFORTABLE TALKING ABOUT BODILY EXPERIENCES WITH.

This invitation is to practice different formats of storytelling. Hormones are either not discussed, or discussed because something awful has happened: pain, disorientation, exhaustion, being mistreated by a loved one or a medical professional. What else can we do? Well, we can draw and we can read detailed accounts about how to understand specific body functions and how hormones are involved. We can make collective sounds based on our heartbeats, or sing. The aim is an experience, perhaps an unusual one; and maybe a shift in how we perceive our internal experiences.

ON HORMONAL AND OTHER TRANSGRESSIONS: QUEERING PCOS

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Bodies are messy, and so are bodily transgressions. Being a gender and a hormone transgressor—a.k.a., a trans person with polycystic ovary syndrome (PCOS)—I know that, more often than not, transgressions are not treated kindly.

In medical terms, PCOS is described as an 'endocrine disorder,' most prevalently characterised by elevated testosterone levels and a plurality of ovarian cysts. That is already an oversimplification as PCOS can come with many other symptoms and attributes, like facial hair growth, insulin resistance, diabetes, infertility, etc.

Upon being diagnosed, trying to make sense of PCOS was in many ways frustrating. The little information that existed revolved around preserving my fertility, and the only 'treatment' I was offered were hormonal contraceptives, that, in the end, messed up my body-mind.

Drawing on Clare, medical practice tends to condense, "our three-dimensional body-minds into two-dimensional graphs and charts, images on light boards, symptoms in databases, words on paper. It holds history and creates baselines. It predicts the future and shapes all sorts of decisions. It unleashes political and cultural forces." [1] Medicine is committed to neatly identifying transgressions with the aim of eradicating, *curing* them. What makes the PCOS-body with its 'excessive' body hair or weight, its lack of fertility or its menstrual irregularity so "dangerous or disturbing or transgressive" is its deviation from normative femininity [2]. This fixation on curing leaves no potential for nuance, and being already confining for cis women, it renders trans people completely invisible.

Incited by this frustration, I conducted interviews with peers on their stories of living in and caring for their trans PCOS-bodies. [3] In contrast to authoritative notions of medical objectivity, I

approached interview participants as holding the most expertise on their own body-minds. [4]

Seeking medical care (whether trans-, PCOS-related, or both) my interlocutors too encountered experiences with a medical system that deems their bodies defective, trying to squeeze them into a rigid binary for the sake of 'normal.' Their own bodily histories, needs, wishes or struggles were ignored or flat-out disregarded, which sometimes paradoxically denied them access to much needed healthcare measures.

However, trans PCOS-bodies, as all bodies, cannot be confined to a set of distinct criteria. Throughout their stories, my interlocutors shared that their bodies took different shapes contingent on the different timelines, trajectories, emotions, identities, or communities they were part of at specific moments in their lives. While our experiences differed in many ways, there were also points of intersection, making the interviews situated affective encounters of relating. [5] Exchanging stories and quips, expressing frustration or engaging in informal chats after the recording device was turned off, my interlocutors and I enacted a space of mutual exchange of affects and care that brought the PCOS-body into being in all its complexities. [6]

Interlocutors embodied a range of practices and knowledges that twist, subvert and reinterpret the norms forced upon their body-minds and the narratives commonly told about hormones, the body, PCOS, or being trans. While they wished for medical support related to certain aspects, they did not consider their body-minds defective as such. Some considered PCOS as proof that bodies, in general, are multiple, diverse and dissimilar. Some even found their PCOS-bodies congruent with their identities, naturally congruent.

Enacting such collective epistemologies through our conversations granted insight into how caring for a transgressive body can look—whether medically or in general. Rather than holding on to norms and thresholds, rather than thinking straight, the stories shared with me call for a queering of PCOS. [7]

Queering something means: "to treat it obliquely, to cross it, to go in an adverse or opposite direction. It has movement and flex in it. Queering is problematising apparently structural and foundational relationships with critical intent, and it may involve mischief and clowning as much as serious critique". [8]

Embracing transgressions, approaching the person and their body in all its fluidity and complexity opens up multiple ways of knowing and living in a body that can capture a persons lived experiences much more accurately, making them more tangible. When it comes to hormonal, bodily, gender, or other transgressions, nuancing and queering them through exchanging different stories is crucial to the ways we know and make sense of them. Because in the end, those stories have consequences on how we care and live with our bodies and the bodies of others.

ANNOTATED REFERENCES

HOW DO WE KNOW WHAT WE KNOW ABOUT HORMONES

[1] How can a person study and understand their own body?

[1a] Deborah Lupton's "The Quanti-fied Self" (free podcast interview with author: https://newbooksnetwork.com/deborah-lupton-the-quantified-self-polity-2016)

[1b] the Bhagavad Gita, translated with commentary by Ravi Ravindra, along with Patanjali Yogasutra, specifically on the subject of self-study (svādhyāya) as discussed in online lectures by Ravi Ravindra.

[1c] Annemarie Mol's "Eating in Theory" (free podcast interview with author: https://newbooksnetwork.com/eating-in-theory)

[2] On the regulation and dysregulation of cycles in non-human beings

[2a] Ribeiro, in the "Oracle of Night" p. 115, citing: Tosches, Maria Antonietta, Daniel Bucher, Pavel Vopalensky, and Detlev Arendt. "Melatonin signaling controls circadian swimming behavior in marine zooplankton." Cell 159, no. 1 (2014): 46-57.

[2b] Paul Huebener writes about in "Nature's Broken Clocks."

[2c] Shansky, Rebecca M., and Anne Z. Murphy. "Considering sex as a biological variable will require a global shift in science culture." Nature neuroscience 24, no. 4 (2021): 457-464

[2d] Woitowich, Nicole C., Annaliese Beery, and Teresa Woodruff. "A 10-year follow-up study of sex inclusion in the biological sciences." Elife 9 (2020): e56344

[3] Notes from: Luqman, A.; Götz, F. The Ambivalent Role of Skin Microbiota and Adrenaline in Wound Healing and the Interplay between Them. Int. J. Mol. Sci. 2021, 22, 4996. https://doi.org/10.3390/ijms22094996

[4] A non-exhaustive list of accessible books about hormones:

[4a] Dopamine:
"The Molecule of More" by Daniel Z. Lieberman, MD and Michael E. Long
Baik, Ja-Hyun. "Dopaminergic control of the feeding circuit." Endocrinology and Metabolism 36, no. 2 (2021): 229.

[4b] Evolutionary development of hormones, cited here for its sections about insulin: "The Story of the Human Body" by Daniel Lieberman

[4c] Environmental factors and endocrine-disrupting chemicals: "Sicker, Fatter, Poorer" by Leonardo Trasande, MD, MPP

[4d] Sex hormones within the context of gender expression, politics, and performance: "Testo Junkie" by Paul B. Preciado

[4e] Sex hormones: "This is Your Brain on Birth Control" by Sarah Hill, PhD (Note: despite a short note on inclusivity in the introduction, "This is Your Brain on Birth Control" brings in a lot of heteronormative framing to its interpretations; however, it was still very interesting in its historical view of "the pill" and summary of research on its effects. I do think there is a lot it can offer to many readers, but I cannot recommend it without mentioning that its interpretation of sex hormone effects is almost exclusively in terms of female attraction to males in a (mostly) procreative context.)

[4f] Melatonin, and its interaction with insulin: "The Oracle of Night" by Sidarta Ribeiro; and "Why We Sleep" by Matthew Walker, PhD." Although I thoroughly enjoyed "Why We Sleep," I noticed that - more than other books - mentioning it caused people I was speaking with to point out that this book was alarmist, and was over-blowing the negative impacts of sleep deprivation. First, I think all the books on this list contain information that is genuinely alarming; and, not being an expert, I can only judge on the basis of the variety of information provided, the clarity of argument, and the response from the respective professional communities of the authors. As a popular book about health, it also simplifies in many places. In this particular case, though, I would suggest: it does not matter. One major argument of this book is that we should sleep more. At one point, it mentions a self-report survey question along the lines of: "How many times in the past week have you woken up feeling well-rested?" If you consider this question, and, in response, grimace or groan, then it does not matter how alarmist the book is or is not; you would probably benefit from more sleep, and you already know it. It is very difficult to prioritise real rest, but it is also important; on the cultural, spiritual, and political register of rest, I would recommend the work of Tricia Hersey, "Rest is Resistance: A Manifesto".

[5] Some (non-exhaustive) threads regarding the healing power of singing together.

[5a] Both of the following studies find that singing - especially choir singing, compared to solo singing - is associated with lower salivary levels of oxytocin and cortisol. There are some challenges to both getting this kind of data and interpreting it. In addition to hormone levels, both studies use different measures of self-reported stress levels, and both studies find that singing reduces stress and improves well-being.

This study is larger, but focuses on cancer patients and their carers: Fancourt, D., Williamon, A., Carvalho, L.A., Steptoe, A., Dow, R. and Lewis,

I., 2016. Singing modulates mood, stress, cortisol, cytokine and neuropeptide activity in cancer patients and carers. Ecancermedicalscience, 10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4854222/

This study is smaller, and uses experienced singers, with great methodological effort to make a non-stressful measurement: Schladt, T. Moritz, Gregory C. Nordmann, Roman Emilius, Brigitte M. Kudielka, Trynke R. de Jong, and Inga D. Neumann. "Choir versus solo singing: Effects on mood, and salivary oxytocin and cortisol concentrations." Frontiers in human neuroscience 11 (2017): 430. https:// www.frontiersin.org/articles/10.3389/fnhum.2017.00430/full

[5b] On oxytocin: Gordon, Ilanit, Carina Martin, Ruth Feldman, and James F. Leckman. "Oxytocin and social motivation." Developmental cognitive neuroscience 1, no. 4 (2011): 471-493. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3185363/

[5c] As part of the Singing Project at the Gropius Bau (2021-ongoing, as of 2023) https://www.berlinerfestspiele.de/en/gropiusbau/programm/2021/veranstaltungen/the-singing-project/uebersicht.html, artist Ayumi Paul offers various means for visitors to consider singing, and to enter song together. In the Sounding Seeds that are part of this work (https://soundcloud.com/gropiusbau/ayumi-paul-sounding-seeds-autumn-2022/ssokSwMsRhsB), the artist offers a telling of the Osiris myth, describing how Isis chants Osiris back into whole-ness, after his body had become disintegrated.

[6] The Resonant Heartbeats exercise was based on an exercise in "Observe, Collect, Draw!" by Georgia Lupi and Stefanie Posavec. I have since incorporated it into courses and workshops through Berlin's School of Machines, Making, and Make-Believe; the School of Commons; the 2022 conference on data sovereignty held by the Weizenbaum Institute in Berlin, Germany; and the 2023 Data for Care working group at NeMe Arts in Limassol, Cyprus, which can be viewed in full here: https://www.neme.org/projects/toolkit-of-care/data-for-care . The connection to critical data discourse is something I describe in my contribution to the Critical Coding Cookbook (2021-2022) here: https://criticalcode.recipes/contributions/critical-data-practice-at-home-and-with-friends; this collection of "recipes" has also influenced the format of the Invitations in this book. The heartbeat exercise in a group in person also attains a sonic character - the tak-tak-tak of pencil-marks - which can be an interesting substrate for connection or discussion; this aspect is described in my essay "Eggland" in The Posthumanist (2023) and can be found here: https://www.are.na/block/22164931

[7] From "Please Do Not Yell at the Sea Cucumber," which appears in "Things that Are" by Amy Leach

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[1] Clare, Eli. "Brilliant Imperfection: Grappling with Cure". Durham and London: Duke University Press (2017). p.41

[2] Fisanick, Christina. "Fatness (In)Visible: Polycystic Ovarian Syndrome and the Rhetoric of Normative Femininity." In: Rothblum, Esther and Solovay, Sandra (eds) *The Fat Studies Reader*. New York, NY: New York University Press (2009): 106–109. p.108

[3] Osipova, Ekat. "Ambiguous Singular, Tangible Multiples: Trans People's Enactments of PCOS-Care" [Master's thesis]. Universität Wien, Vienna, Austria (2021). Available at: https://utheses.univie.ac.at/detail/61705#

[4] Haraway, Donna. "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective." *Feminist Studies* 14, no. 3: 575–599. Available at: https://philpapers.org/archive/harskt.pdf

[5] Ayata, Bilgin, Harders, Cilja, Özkaya Derya, and Wahba Dina. "Interviews as situated affective encounters. A relational and processual approach for empirical research on affect, emotion and politics." In: Kahl Antje (ed) *Analyzing Affective Societies: Methods and Methodologies*. London and New York: Routledge (2019): 63–77.

[6] Seeck, Francis. "Care trans_formieren: Eine ethnographische Studie zu trans und nicht-binärer Sorgearbeit." Bielefeld: transcript (2021). Available at: https://www.transcript-verlag.de/media/pdf/12/de/53/oa9783839458358MJBlVsmUFhuZ3.pdf

[7] Ingraham, Chrys. "Thinking Straight: The Power, the Promise, and the Paradox of Heterosexuality." London and New York: Routledge (2005). Available at: http://xyonline.net/sites/xyonline.net/files/2022-03/Ingraham%2C%20Thinking%20straight%20-%20the%20promise%2C%20the%20power%20and%20paradox%20of%20heterosexuality%20%282005%29.pdf

[8] Light, Ann. "HCI as heterodoxy: Technologies of identity and the queering of interaction with computers." *Interacting with Computers* 23, no. 5 (2011):430–438. p. 432 Available at: https://www.researchgate.net/publication/220055189_HCI_as_heterodoxy_Technologies_of_identity_and_the_queering_of_interaction_with_computers#fullTextFileContent

BIOGRAPHIES

i0 xen0 is a researcher, artist, and transsexual based in Berlin. It has an academic research background in science and technology studies, as Kit Kuksenok. Its visual and performance art focuses on how people understand and imagine the internal structures and processes in their bodies, including through technologies of voluntary and involuntary bodily surveillance. All aspects of i0 xen0's academic and artistic work are informed by embodied contemplative practice. This book reflects its research 2020–2024 on how people collectively comprehend hormonal experience, which included the 2022 School of Commons residency programme.

Ekat Osipova is an interdisciplinary researcher interested in topics related to queer and crip embodiments and practices. Currently, they are a PhD candidate in human-computer interaction exploring how fellow neurodivergent folks experience technologically-mediated intimacy. Ekat has a background in science and technology studies.

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HOW DO WE KNOW WHAT WE KNOW ABOUT HORMONES

HumDrumPress is a collaboration-based publisher. Roles and responsibilities are therefore shared by all parties, within their capacities. The following persons contributed in a multitude of ways to making this publication possible: **Amy Gowen, Ekat Osipova, Kit Kuksenok, Wibke Bramesfeld**

Images cover:
TOP: A swimming pinkish orange translucent holothurian (Elasipodida) with intestinal tract visible. Material in gut is similar to seafloor dung piles seen widely over world ocean sea floor.
Image ID: expl5475, Voyage To Inner Space - Exploring the Seas With NOAA Collect.
Photo Date: 2010 July 27. Credit: NOAA Okeanos Explorer Program, INDEX-SATAL 2010. https://upload.wikimedia.org/wikipedia/commons/7/73/Expl5475.jpg
BOTTOM: A spectacular image of a benthopelagic sea cucumber swimming in the near freezing waters of the abyss.Image captured by the Little Hercules ROV at 3205 meters depth on "Site K," explored July 27, 2010 during the INDEX SATAL 2010 Expedition. Image courtesy of NOAA Okeanos Explorer Program, INDEX-SATAL 2010.
Source: http://oceanexplorer.noaa.gov/okeanos/explorations/10index/logs/slideshow/ex_july_highlights/slideshow.html#
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http://bask.guide/hormones hosts a digital version of this text, with additional resources about this work.

The physical version of this book was created by HumDrum Press. The drawings in this book are the body maps (Invitation #1) created by participants in the School of Commons 2022 cohort, in sessions facilitated by the author.

Invitations

1. Body Maps
2. The Foundation
3. Rhythm and Event Archaeology
4. Impact Lines
5. Singing in a Shared Space
6. Energy Diary
7. Resonant Heartbeats
8. Collective Hormone Epistemology

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